# CHAPTER 2
# PURPOSES AND LIMITATIONS OF GROUTING

2-1. Purposes. Pressure grouting involves the injection under pressure of a liquid or suspension into the voids of a soil or rock mass or into voids between these materials and an existing structure. The injected grout must eventually form either a gel or a solid within the treated voids, or the grouting process must result in the deposition of suspended solids in these voids. The primary purposes of pressure grouting a soil or rock mass are to improve the strength and durability of the mass and/or to reduce the permeability of the mass. This manual provides guidance in the use of pressure grouting as a means to improve existing or anticipated subsurface conditions. Information on procedures, materials, and equipment for use in planning and executing a grouting project is included, and types of problems that might be solved by pressure grouting are discussed. Methods of pressure grouting that have proven to be effective are described, and various types of grouts and their properties are listed.

a. Permeability Reduction. Grouting applications relating to permeability reduction include: (1) in association with other measures, reduction of hydrostatic forces acting on the base of water retention structures and on tunnel linings; (2) reduction of reservoir water loss; (3) in association with other measures, inhibition of internal erosion of foundation and embankment materials; and (4) facilitation of excavation by stabilization, consolidation, and/or water control. For those applications involving structural safety (i.e. hydrostatic force reduction and erosion inhibition) grouting is not to be considered as the sole defense. Multiple defenses, such as grouting in association with drains and/or filters, are to be used.

b. Improvement of Mechanical Properties. Grouting applications relating to mechanical property improvement include: (1) enhancement of bearing capacity, and (2) consolidation of overburden or highly fractured rocks to facilitate surface or underground excavations.

c. Void Filling. Grouting may be necessary to fill both surface and subsurface voids.

d. Stabilization and Lifting. Grouting is used for the stabilization of foundations and for lifting and stabilization of footings, slabs, and pavements.

2-2. Limitations. There are two general types of limitations that apply to grouting: (1) limitations inherent in the physical nature of the grouting materials and in the physical and chemical properties of the materials that the grout will contact, and (2) limitations on grouting operations and methods. Specifically, grouting limitations are delineated in the following paragraphs.

a. Physical Limitations. Some physical limitations on cement grouting effectiveness are:

(1) The maximum and minimum size and geometry of voids to be grouted.

(2) The particle size of the cement, bentonite, or other solid constituents in the grout mix.

(3) The presence of minerals in the groundwater or foundation materials that have a detrimental effect on grout strength, setting time, volume, or permanency.

(4) The possible noncompatibility of grouting materials used in the mix.

(5) The presence of clay or other erodible materials in the foundation that cannot be completely removed by washing.

(6) Settlement of cement particles from suspension in the grout.

(7) The presence of unknown subsurface features or conditions detrimental to the grouting program.

b. Limitations. Examples of limitations to grouting effectiveness related to field operations and methods include:

(1) Uplift and damage to foundations resulting from excessive pressures.

(2) Use of improper drilling and grouting equipment.

(3) Improper plugging of foundation voids by thickening the mix prematurely or by unsuitable injection methods.

(4) Improper hole spacing or orientation of grout holes.

(5) Failure to utilize experienced geological and inspection personnel to supervise and inspect drilling and grouting operations.

2-3. Selection of Methods of Treatment. Grouting is one method of treating subsurface materials to reduce permeability or improve strength and stability. However, other methods of treatment may be required in addition to or in lieu of grouting. As stated, where structural safety is involved, the multiple defense approach will be required. The selection of grouting as the method of treatment should be based on an evaluation of all pertinent aspects of the problem, including engineering needs, subsurface conditions, and economic considerations.